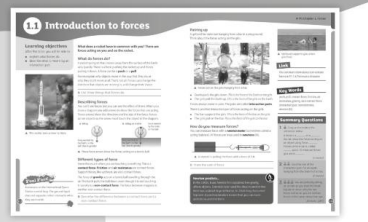
1.1 Introduction to forces



Physics NC link:

- forces as pushes or pulls, arising from the interaction between two objects
- using force arrows in diagrams, adding forces in one dimension
- forces measured in newtons, measurements of stretch or compression as force is changed
- opposing forces and equilibrium: weight supported on a compressed surface.

Working Scientifically NC link:

- make predictions using scientific knowledge and understanding.

Band	Outcome	Checkpoint	
		Question	Activity
Developing	Identify some forces acting on objects in everyday situations (Level 4).		Starter 1, Plenary 1
	Identify an interaction pair (Level 3).	2	Main 1
	Use a newtonmeter to make predictions about sizes of forces (Level 4).		Main 1
Secure	Explain what forces do (Level 5).	A	Main 2
	Describe what is meant by an interaction pair (Level 6).	2	Starter 2
	Make predictions about forces in familiar situations (Level 5).		Main 2, Plenary 1
Extending	Explain the differences between contact and non-contact forces (Level 6).		Starter 1
	Explain which pairs of forces are acting on an object (Level 7).	3	Main 2
	Make predictions about pairs of forces acting in unfamiliar situations (Level 7).		Main 2

Maths
In the student-book activity students use units for force.
Students can use size and scale and the quantitative relationship between units in the practical.

Literacy
In the student-book activity students use scientific terms confidently and correctly in writing about forces.
Students can make clear descriptions of forces when using newtonmeters.

APP
Students can use abstract models to explain forces (AF1).
Students can select appropriate formats to present data (AF3).

Key Words
push, pull, contact force, friction, air resistance, gravity, non-contact force, interaction pair, newtonmeter, newton (N)

Answers from the student book

In-text questions	**A** Forces change the shape, speed, or direction of motion. **B** For a contact force to act the objects have to be touching (e.g., the air and a car for air resistance) but non-contact forces act at a distance. **C** newtons
Summary questions	**1** push, pull, arrows, interaction, newtonmeter (5 marks) **2** The force of the Earth on the apple AND the force of the apple on the Earth OR the force of the tree on the apple AND the force of the apple on the tree. (2 marks) **3** 6 mark question. Example answers: The Earth exerts a force on you. You exert a force on the Earth. The chair exerts a force on you. You exert a force on the chair. These are two interaction pairs. The two forces acting on you are from two different interaction pairs. This means one can be bigger than the other.

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Starter	Support/Extension	Resources
What's the force? (10 min) Students recap on what forces are (from KS2), and individually name as many forces as possible. **Who pulls harder?** (10 min) Give groups of students a pair of newtonmeters, linking the hooks together. Ask them to predict the readings on each newtonmeter if one student holds their newtonmeter and the other student pulls theirs away.	**Support**: Show a picture as a prompt for listing forces, for example, forces acting on a cyclist.	
Main	**Support/Extension**	**Resources**
At this point it is important that students are clear on the effects and names of forces, as well as what interactive pairs are. **Measuring forces** (20 min) Introduce students to the idea of a newtonmeter and measuring forces in newtons. Students measure the force needed to carry out different activities (e.g., to lift a pencil case) and record these in a table. Students should compare readings with each other, explaining differences. For accurate readings, the newtonmeter hook should be in line with its spring. **Force arrows** (15 min) Introduce students to force diagrams and force arrows. Give students three arrows of different lengths cut out of card. Students choose an arrow each time they measure a force, showing the direction of the force and comparing its size.	**Support**: Make sure the forces are straightforward to measure. For example, objects with hooks or straps. **Extension**: Students prepare their own table to record results. Students identify several forces acting on one object and explain why they chose these groups, for example, as pairs of interaction forces.	**Practical**: Measuring forces
Plenary	**Support/Extension**	**Resources**
Comparing the size of forces (10 min) Students list at least six situations involving forces and put these in order, ranked by size. This can be done using the list from the interactive resource or non-interactively on the board. **What's the difference?** (10 min) If students have measured the same thing during the practical (for example, lifting a book) ask them to compare results. Students suggest reasons for any different results, for example, linked to technique.	**Support**: Supply a list and ask students to rank these forces by size. **Extension**: Ask students to estimate the size of different forces in newtons.	**Interactive**: Comparing the size of forces
Homework	**Support/Extension**	
Provide students with a strong rubber band stapled to the top of a piece of stiff card, and tie one side of the top of a small sandwich plastic bag to the other end of the rubber band. Attach a piece of paper to the elastic band as a pointer. Students use this to measure forces at home calibrating the scale using their own units, depending on what is available to measure, by placing items in the plastic bag.	**Support**: Calibrate the newtonmeter in the classroom and ask students to use it to measure forces at home. **Extension**: Ask students to make their own newtonmeter using their own design.	